General Physics

APPLICATION OF CLASSICAL AND COMPUTATIONAL METHODS TO A BOUNDARY VALUE PROBLEM IN ELECTROSTATICS

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Boundary value problems are well known to anyone in physics or engineering and are essential to the understanding of electrostatic theory. They generally consist of a set of boundary conditions along with Laplace's equation with the goal of finding the general potential in some region of space.

This presentation will focus on solving a specific boundary value problem in spherical coordinates, emphasizing techniques learned at both the undergraduate and graduate level. However, the problem lacks the typical symmetries that greatly simplify most problems of this type. The solution, as is typical, involves an infinite series of spherical harmonics along with a power series in the radial coordinate. The computation of individual terms of the series was automated using Mathematica 3.0. Also, the solutions are plotted in three dimensions with a varying number of terms to demonstrate the rates and degree of convergence. The plots also verify the correctness of the solution by comparison to the given boundary conditions.

What distinguishes this approach from most is the introduction of the computational aspect as an integral part of the learning process. They can also give a more concrete sense to an abstract concept, thus elucidating the instructional process.